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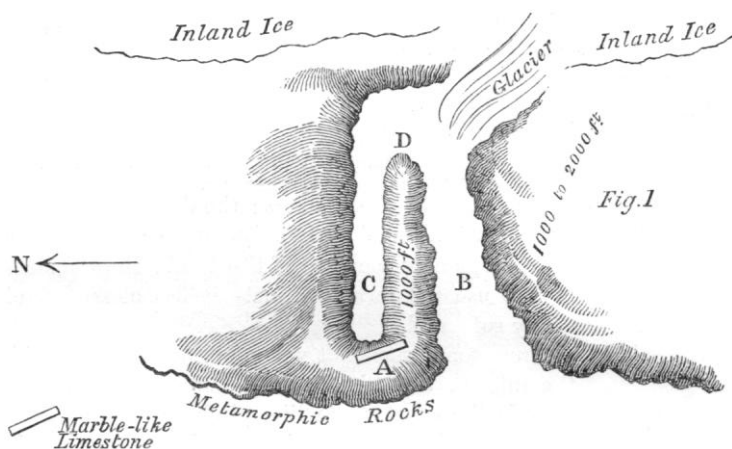
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a fiord be cut by a glacier? Even if we grant it the power to cut the arm B, it will be hard to explain the arm C; on the same theory



The barrier at A is so high that the existence of the arm C was not suspected until turning the point D.

I maintain that the fiords were in existence prior to their invasion by glaciers. As to their origin, I think the geologist in Greenland will see in the immense number of erupted dykes and upheaval, distortion, and fracture of the older stratified rocks, a cause more adequate to the effect than ice "hollowing."

Alberton, Prince Edward Island,
November 4th, 1869.

ADDITIONAL NOTICES.

(Printed by order of Council.)

1. *Notes on the Climate and Geology of Abyssinia, with Table of Heights.*
By H. Cook, M.D., Surgeon Bengal Army.

THE climate of the low-lying strip of country skirting the mountainous region of Abyssinia proper, on the sea-board, differs from that of the Highlands extremely—differs, indeed, as much as if the countries themselves were severed by wide tracts of ocean or parallels of latitude; the climate of the one resembling in many points that of Scinde, that of the other more nearly approaching the climate of the Neilgherries.

The seasons of the two countries differ widely: those of the lowlands, like

those of Scinde, having only a division into a hot weather and a colder one, with a very light and precarious annual rainfall; those of the highlands presenting the anomaly of a tropical arrangement into a hot, a cold, and a rainy season, with an European temperature, and a tropical monsoon.

The seasons, then, of the low country may be said to consist, like those of Scinde, of a hot, and a comparatively cold season.

In November the mean daily maximum was $96^{\circ}.4$, and the extreme maximum 105° ; while the mean minimum at night was $67^{\circ}.4$, the lowest point reached being 66° . The diurnal range was thus 29° . The air was dry, the mean difference between the dry and wet bulb thermometers being 13° .

The months of December and January were cooler, the mean maximum reaching 90° , and the extreme maximum 96° ; the mean minimum 70° , and the lowest temperature 63° . The air was somewhat less dry.

In February, the rain—which was expected to have made its appearance before, but did not—fell in light showers, generally during the morning and evening, reducing the maximum temperature to $84^{\circ}.6$, and the extreme maximum to 91° ; while the difference between the dry and wet thermometers fell to 7° . The mean minimum at night was $71^{\circ}.8$, and the lowest point reached 67° .

It was, perhaps, advantageous to the health of the force located on the coast that the rainfall was so scanty during this season, as had it been long continued it would probably have engendered fevers more destructive than the effects of the heat and drought. The rain, indeed, was very pleasant, as it gave for a time some respite from the clouds of dust which habitually hung over the camp, and produced a state of chronic dust-storm most unpleasant to exist in; a thorough dust-storm, which, like those of Scinde, occasionally occurred, was beneficial, as it cleared the atmosphere of the oppressive sultriness which the peculiar electrical condition coexistent with atmospheric dust occasions, and lowered the temperature considerably for the time.

Even with the small amount of rainfall which took place, the aspect of things changed considerably; the scanty-leaved acacias threw out fresh shoots, the dust-covered salicornias which cover the sandy plain grew green again, and a thin green herbage made its appearance, where all before looked dead.

Throughout the cold season the land and sea breezes occurred with pretty much regularity. At night, some hours after sunset, a light westerly wind set in, which continued until morning, and occasionally for some time after sunrise; then occurred a lull, which at times was most oppressive until ten or twelve o'clock, when the longed-for and life-giving sea-breeze usually commenced from the east or north-east, and blew strongly until evening, when the lull recurred, until the land-breeze recommenced from the west.

In the month of March the hot season began, and the heat grew in intensity, until in the early part of the month of June the mean daily maximum reached 105° , and the minimum rarely fell below 83° ; giving an estimated mean temperature of 94° . The sea-breeze, however, happily still continued, and, indeed, blew with greater force as the soil became more intensely heated by the sun's rays. The air was very dry, there being often a difference of from 20° to 24° between the readings of the wet and dry thermometers; and the maximum heat in the sun's rays reached 145° .

At Kumayle, ten or twelve miles further inland, the heat was still greater as the sea-breeze became heated in its passage over the burning sands of the plain. Here the thermometer marked 109° in the shade daily; and a violent gust of wind, instead of cooling the air, had the effect of raising the thermometer a degree or two higher.

The climate of the fifty miles of the pass varies, of course, greatly with the difference of elevation, but it assimilates more nearly with that of the lowlands,

The rainfall of the cold-weather months extends up as far as Suru, or Umdul Wells (or about 3900 feet); while that of the monsoon of the highlands extends generally about the same distance downwards, though its effects in the shape of floods and torrents are felt throughout its length.

The temperature at Suru during the ascent of the army in February and first half of March was moderated by the effects of the rain on the mountains, and of the clouds and mists which continuously hung about their summits. The nights were much cooler than those of the plains, and the range of temperature greater, thus resembling the conditions of the mountain climate at Senafé. On clear days, however, when no clouds intervened, it became evident that the confined air in the pass could become heated equally with that of the plains, though some 3000 or 4000 feet above them. Thus the maximum temperature in March reached, on several occasions, 90° and 98°; while at others it was in the same month as low as 72°. The thermometer in the sun's rays rose on two occasions to 141°.

On the return march in May the heat at Suru was very great, very little, indeed, less than that of Kumayle, the maximum thermometer reading in the shade 105°. At Rahaguddy (some 3800 feet higher), in the month of March, the maximum temperature had decreased to 86°, and the minimum to 58°.5.

I have mentioned the natural division of the seasons of the highlands into a cold-weather, a hot, and a rainy season or monsoon. The cold season may be said to extend from October to February, the hot from the beginning of March to the middle of June, and the wet from this time to the end of September.

The only month of the cold season of which I have reliable data collected at Senafé is December, which may, perhaps, be taken as a fair mean of this season generally, though colder weather occurred in the following month.

The mean maximum for this month was 73°.6, and the mean minimum 43°, giving an estimated mean temperature of 58°.3. The extreme maximum was 77°, and the lowest temperature registered 39°, showing a range of 38° during the month. The prevailing wind was from south-east. The days were very pleasant, but the nights very cold under canvas, with heavy dews.

During the month of March (at the commencement of the hot weather) the nights still remained cold, giving a mean minimum temperature of 52°; but the heat during the day had considerably increased, the mean maximum being 80°, and the greatest maximum 84°. The range between the mean temperatures was 28°. The air was very dry during the day, the difference between the mean maximum dry-bulb readings and those of the mean maximum wet being 20°.5.

Thunderstorms occurred on several occasions, and during one which happened on the 29th, one inch of rain was gauged. The general direction of the wind was easterly, occasionally veering to the north or south; and on several occasions a westerly or land wind prevailed during the early part of the day.

The month of April was the hottest of the hot-weather months; the mean maximum was 81°.5, the mean minimum 54°.5; the extreme maximum 86°, and the extreme minimum 49°. The dryness of the atmosphere differed nothing from that of the previous month. There was a pleasant amount of cloud tempering the sun's heat, and a fresh breeze from the east and south-east during midday. The land breeze from the west occasionally blew during the early hours. Thunderstorms were prevalent during the latter half of the month. Rain fell on three occasions, giving a total of 1.4 inch.

The month of May was milder; rain, generally accompanying storms of thunder and lightning, fell almost every day for the first half of the month, not heavily, but in sufficient quantities to render the air soft and genial and decrease the temperature.

The mean maximum for the month was 77° only, and the mean minimum

54°·5; the greatest maximum 83°·5, and lowest reading 49°. The range of temperature was therefore less, the mean diurnal range being 22°·5, and the extreme range during the month 34°·5. The estimated mean temperature was 65°·7.

The wind continued easterly and south-easterly; the days were generally cloudy, or with alternating cloud and sunshine.

Throughout these months the quantity of atmospheric ozone was never deficient in any very marked degree, but gave generally high averages. The mean quantities for the month of March were 4.0 by day and 6.2 by night; for April, 2.9 by day and 5.9 by night; and for May, 5 by day and 7.3 by night. As in Europe, it was found that there was a marked excess by night over that of the day, in damp soft weather as compared with dry, and after the occurrence of storms of thunder and lightning; but, contrary to European experience, the east wind was the ozoniferous one, as it bore with it the influence of the sea.

During a portion of the last month of the cold season (February) and the first six weeks of the hot, especially towards the southwards, rain is expected to fall. These rains are termed the "Rains of Bounty," but the quantity and season of their fall seem alike precarious and uncertain. At Magdala, in 1867, there were but ten days in March and two in April on which rain fell, and at Senafé rain occurred only on two or three days in March and on five in April.

This description of the general characteristics of the climate of Northern Abyssinia holds good throughout the three great divisions of the country, Tigré, Amhara, and Shoa, though there are variations of temperature corresponding with differences of elevation.

Through the kindness of Dr. Blanc, who lent me his meteorological journal kept at Magdala, I have been able to prepare a table of mean temperatures for the seasons at that place; and in the 'Transactions of the Medical and Physical Society of Bombay,' for the year 1843, is a paper on the Climate of Shoa, by Dr. Kirk, who accompanied the Embassy to the Court of Shoa in 1841.

At Magdala the mean temperature of the cold-weather months, from October to February, was 56°·2. Of the hot season, from March to June, 65°·5, while that of the wet season, from July to September, was intermediate, and gave a mean of 60°.

At Ankober in Shoa, lat. 9° 35' N., the mean temperature of the cold season was 52°·6; of the hot, 58°·5; and of the wet or monsoon season, 56°·3.

At Magdala, in the year 1867, the number of rainy days in the month of July was 22, in that of August 25, and in September 10. At Ankober in 1842 there were 28 rainy days in July, 28 in August, and 24 in September.

The most remarkable point in the climate of Abyssinia is this occurrence of a well marked rainy season, or monsoon, in a climate otherwise strictly temperate. Rainy seasons, such as the well known south-west monsoon of Western India, occur also in other parts of the world, as in Guinea, Mexico, and Central America, and to a less extent elsewhere, but these are all in tropical climates and combined with very high temperatures.

Occurring as it does here in what would otherwise be the height of the hot season, it exercises an important influence in moderating the temperature, increasing the fertility of the country, and in keeping up its water supply; but its importance does not cease here: the water thus poured out on the mountains of Abyssinia, as Sir S. Baker has so graphically shown, forms a most important element in the annual overflow of the Nile, and in this way the Abyssinian monsoon is perhaps of hardly less importance than that of India.

The extent of country over which this monsoon falls includes the whole of Abyssinia proper, and a large tract of country lying to the westward; probably from the 8th to the 16th degree of north latitude, and in breadth from the 40th to 35th meridian of east longitude.

The amount of rainfall is doubtless unequal: less to the eastward and north-

ward, more copious to the westward and southward, of the mountain-system. I do not think that in the region around Senafé there is a very heavy fall. The evidences of a copious monsoon, as I have seen them on the Western Ghats of India, are altogether wanting. The houses and churches are flat-roofed, and constructed of materials but ill fitted to withstand heavy or long-continued rain; the trees are bare of moss and ferns, and there are no collections of water into ponds or lakes. It is only as we journey to the southward that these indications of a moderate fall are lost. At Addigerat the houses are still principally flat-roofed, though here and there a circular thatched roof is seen. These increase in proportion until after passing Antalo (a hundred miles south of Senafé) none but circular, high, conical roofs are met with.

In the mountainous region of Wojerat, south of Antalo, the forest is dense, and the trees are thickly hung with moss and drooping festoons of ferns, two of which are identical in species with those found in the forests of the mountain ranges of Western India, where the rainfall amounts to 250 inches during the monsoon. South of this parallel of latitude are the lakes of Ashangi, Haik, and Dembea, and here also are those wonderful river-systems where the streams run through valleys of erosion 3000 feet below the level of the surrounding country. Dr. Kirk estimated the rainfall at Ankober to be about 100 inches, judging from his knowledge of the fall in Western India. This may be a fair estimate of the fall at Ankober, but I believe that this amount is considerably exceeded in other parts of the districts over which the monsoon extends, but not in the north-eastward.

The suddenness with which the rainfall commences on the eastern ridge of the table-land is remarkable, and also the fact that none takes place over the Conkan, or seaboard, as is the case in Western India, where the fall is heavy over the Conkan, and is rapidly dissipated towards the opposite flank of the mountains, so rapidly, indeed, that in some localities there is a difference of 150 inches in the space of fifteen miles easting. In Abyssinia the downpour would appear to increase in amount as the clouds pass westward, until the moisture is dissipated over the burning plains of the Soudan. The wind-currents during this season of the year are east and south-east, pointing toward the tract of country, in the centre of the continent whose vast deserts, being heated more and more as the sun passes northward, become the foci of the indrawing masses of atmosphere, and thus the mainspring of the whole phenomena. The great volume of moist air that is thus drawn in over the country comes from the region of the Indian Ocean or Arabian Sea, over which at this time of the year the south-west monsoon, laden with moisture from the Equatorial Sea, is blowing. The series of causes, therefore, which in action bring about the south-west monsoon of Western India, have a distinct and connected influence on the amount of rainfall on the Abyssinian mountains, and thus on the welfare and prosperity of Egypt.

Sketch of the Geology of the Lowlands.—A stretch of sandy plain, but a few feet raised above sea-level, skirts the mountain ranges which form the high-lands of Abyssinia.

This plain, on the shores of Annesley Bay, varies in width from 1 or 2 miles to 10 or 12. The sand of which it is composed is exceedingly soft and loose above, but becomes hard and laminated below, until at a depth of 40 or 50 feet it rests on a coarse gravel, composed of quartz and the débris of trap-rock.

Rising above the sandy level in the vicinity of Tooka are two or three isolated ridges of volcanic origin, some 60 or 80 feet high. These are composed of trap, massive in some strata, ashy and friable in others, capped with a layer of basalt, and pierced by dykes of a red, spongy, and vesicular trachyte. The strike is more or less north and south, and the dip west.

Near the southernmost of these hills a well was dug some 45 feet in depth, which yielded water of a temperature of 115°.

South of Tooka the mountain ranges approach nearer the waters of the bay, leaving only a narrow strip of sandy shore, which is thickly covered with the débris washed down from the hills, consisting of masses of granite, gneiss, felspar, and quartz.

On the south of the bay rises a cone-shaped hill of trap-rock, which has evidently been the outlet of a volcano now extinct. In its vicinity there are quantities of obsidian, red porous tufa, and pumice.

On the opposite side the bay is bounded by the peninsula of Bari. The hills here are composed of metamorphic strata, of which mica-schist, mica-slate, and gneiss are the chief components, and further south, towards the bottom of the bay, these are overlaid by strata of trap-rock.

Traversing now the sandy plain from Tooka towards the mouth of the pass at Koomaylie for some 6 or 8 miles, we cross the southern spur of the Gideen mountains (an outlier of the great ranges), which is here composed of metamorphic rock; and then an intervening level tract of firmer sand, we reach Koomaylie, which is some 450 feet above the level of Tooka.

The scenery here is grand. Range behind range of wooded hills can be distinctly made out, their outlines running down, meeting and interlacing in the centre, marking the line of the winding torrent-bed, while far above all, and usually shrouded in mist, rises a huge peak which crowns the view, and indicates to some extent the height to be attained during the ascent of the 50 miles of Pass to the distant table-land.

Geology of the Pass.—The hills skirting the plain, the outlying ranges, are low, thickly covered with stunted jungle and stony débris, which hide to a great extent their conformation. The strata are much tossed and jumbled, and the dip varies, but is generally eastward; the strike follows that of the great range.

The line of the Pass winds greatly, but follows a w.s.w. course.

Proceeding up the Pass, the strata are at first composed of soft, friable metamorphic schists, with the mica arranged in flaky layers between the harder constituents of the rock, and studded thickly with coarse earthy *garnets*. These are generally of the true crystalline form, rhomboidal dodecahedrons, and at times translucent, but more often earthy and dull.

Further on the strata vary much, in some places compact and solid, in others fissile, and passing into a black shale containing thin seams of *plumbago*, some of which gave a clear blacklead line on paper.

As the Pass closes in until it reaches its narrowest limit, some 15 or 20 feet in width, the strata become more solid; *gneiss* takes the place of the shales, and in one place a granite rock of great thickness is reached, while vast boulders of *greenstone* and allied rocks choke the narrow gorge.

After this, which has somewhat the appearance of an anticlinal axis, the strata again become more schistose, and as they do this the sides of the gorge become less perpendicular and slope away at various angles, until at Sooroo, some 12 or 14 miles from the commencement of the defile, the Pass opens out into a narrow valley.

The water wells up here in considerable quantity at a temperature of 83°, and thence flows down the Pass to Lower Sooroo, at the entrance to its narrowest portion.

The Pass from hence to Umdel wells, about 12½ miles, is more open, and the strata schistose; height about 4000 feet.

At Raraguddy it again narrows, but between these places are some open spots, and through the ravines and gorges which open into the main Pass glimpses of the mountains forming the back-bone of this elevated region are obtained. These summits are flat, and capped with an enormously thick stratum, white in colour, which is probably trachyte.

After leaving Raraguddy the strata continue to be metamorphic schists

for three-quarters of the ascent, when these cease, and are replaced by trap; sometimes earthy, at others volcanic ash, and again trachytic. The trachyte is white, very closely resembling a very fine sandstone, but in some places columnar.

The summit of the Pass is about 8000 feet in altitude, and the view down it magnificent. The table-land on the summit is narrow, and its level broken by several ranges, some of which rise 1000 feet above it. These are composed chiefly of trap, but on the west rise some remarkable rocks of sandstone, which, shutting in the valley on that side, run down on their western flanks some 800 or 1000 feet into ravines, which, commencing thus suddenly, stretch away for many miles westward, until they merge into a broader vale, apparently running north-east and south-west, at a considerably lower altitude. The scarped hills on each side the ravines show the long continuous parallel lines marking the trap-formation.

The height of Senafé above the sea, derived from a series of observations with the mercurial mountain (Newman's) barometer, and by the boiling-points of three thermometers, I have placed at 8175 feet. The heights of places southward I estimated chiefly by a pocket aneroid, set to the mean corrected mercurial barometer readings. This aneroid was corrected for temperature, and, on my return to Senafé, varied in a very trifling degree only from the reading of the mercurial left there. The mercurial barometer had previously been compared with the standard-bar at the Observatory in Bombay, and on comparison again at Zulla, with the barometer on board *H.M.S. Octavia*, the readings were almost identical.

The route to Ashangi trends almost due south, and runs along the same elevated ridge or table-land reached at the head of the Pass at Senafé. It varies much in width; in some places spreading out into broad downs, in others reduced to a narrow neck by the deep valleys, which commence abruptly on either hand, with sudden descents of many hundred feet. The altitudes vary also, falling to 6900 at Agula and Dongola, and rising at the mountain passes of Attalu and Bolago to 9800 and 10,400 feet; while still further south on the Wadela plateau an elevation of 10,800 feet is attained.

Leaving Senafé, the route passes south to Goongoona, distant about 12 miles. The metamorphic series of rocks is met with for the last time for many miles, in crossing the spurs of the eastern range of hills; and we then reach the massive sandstone hills, which rise above Goongoona to a great height. The sandstone contains, I believe, no trace of any fossil. The strata are enormously thick and massive, and horizontal in position.

The route to Fokada passes first over a lower range of this sandstone, on to some broad grassy downs, free from hill-ranges until nearing the latter station, when sandstone is again reached. Farther on the road winds on the brink of a sudden declivity, where commences a series of valleys, bounded by parallel scarped hills, along whose sides are traceable the continuous lines spoken of before, as marking the trap-formation. The scene resembles many such amidst the trap-hills of the Dekkan. In the far distance are visible some high peaks, which are said to mark the position of Adowa and Akun.

The plain of Fokada is formed of "black soil" (like that of India), and a substratum of black basaltic trap, while on the north towers a hill of columnar trachyte. At Addigerat the ranges, which run more or less north and south, are composed of sandstone capped by trap—either basalt or trachyte, and lying on trap. They are from 500 to 800 feet in height. This formation continues to Mai Wuhiz, 14 miles distant, on the road to which we pass an excavation in this sandstone, which has evidently been intended as a small Cave Church, a sort of prototype of the grander Cave Church met with further

south. The excavation is about 18 feet by 12, with side aisles, and a semi-circular apse at the east end. The trap strata capping the sandstone hills in the vicinity are columnar.

From this to Addabaga, 16 miles, we pass over the broad plains of Haramât, bounded by parallel ranges of the same sandstone and trap formation. On the eastern range, close under which the road passes, are some well built circular towers. On the right the range terminates in a high pyramidal mountain, on which is placed the stronghold of Endâtsien, one of the strongest forts of Tigré. The sandstone strata are red in colour below, and white above. The elevation of this tract is much the same as that of Senafé; but in marching to Dongola, 10 miles distant, we descend about 1000 feet, and on reaching the lower level pass over strata of the metamorphic series. At one spot the ground was covered with great quantities of slag, and the guide informed me that for many years iron-ore had been worked there.

At Dongola we reach the termination of the sandstone series on this parallel of latitude. The strata, which have continued more or less horizontal, here dip south, and are overlaid by the commencement of a series of limestone strata which extends from this spot for 60 miles to the southward. A spur of the sandstone hills runs just beyond the valley of Dongola, shutting it in on the south, and in this is the Cave Church for which this locality is celebrated. There are three other such churches still existing, one at Avrahas-vaha, in this locality, a second at Wombarta, in the sandstone hills, about 14 miles distant, and a third at Lalibela in Lasta. It is said that ten cave churches were thus excavated by the Emperor Lalibela in olden times.

In advancing from Dongola to Agula, 9 miles, we pass over a series of low rounded hills of this limestone, which are generally stony and barren, or covered with low mimosa-scrub. At Agula are the ruins of the Church of St. Kirkos. The valley is traversed by a stream of considerable size, flowing westward. The limestone strata are here and there interleaved with a harder stratum of arenaceous limestone, almost approaching a sandstone in character, but containing traces of fossils.

The 16 miles of route to Dolo cross over three ranges of hills, running more or less east and west. The whole tract is stony, barren, and deserted; a condition of things which seems to characterize the limestone formation. The plain of Dolo, however, is green, and well watered by a stream of moderate size.

At Eiklut, 9 miles further on, there is a good deal of vegetation and water, but the substratum is trap rock.

Passing over more limestone hills, we descend a ghat to the broad plain of Antalo, on which our fortified camp was placed (the town of Antalo lying on a spur of a high hill on the west of the plain). The plain is covered with a layer of "black soil," indicating the nearness of the trap-formation, which recurs here, as I ascertained on my return route, when I passed northward to Chelicut. The road to the latter place from the camp passes across the plain northward, and then through some very broken country into the valley of Chelicut.

In traversing the plain I passed over strata of limestone, and reached a spot where nodular basalt cropped up, and in this vicinity found some limestone of a dark blue or black colour, and subcrystalline texture, containing white casts of an indistinct bivalve. Further on the trap series became more marked, and in ascending again from Chelicut, which lies about 500 feet below Eiklut, to the latter place, the strata for most of this thickness were of trap.

Passing south from Antalo to Meshuk, 16 miles, the route lies over high ranges of hills, which run almost east and west. These are of limestone, and on descending into the valley of Musgi, which lies midway, a still higher

series of mountain-ranges comes into view, the first range of which is cross cut by the pass. It is here, in this natural section through the range, that one of the most interesting points in the geology of this district occurs. The pass is very narrow, and filled with most luxuriant vegetation, while down it rushes a beautiful stream of water, overhung by the branches of the stately trees which fill the ravine, and fringed by masses of beautiful ferns and flowering plants of European species.

The pass is flanked on the east by towering masses of enormously thick sandstone strata, cropping up beneath with a *clay-stone trap*, mottled white and red. Further on, on the same side of the pass, and *apparently* underlying the sandstone, was a very massive stratum of fine-grained limestone, containing small indistinct fossil casts, while on the west side of the pass the strata were contorted and elevated, and the dip in some places was almost vertical. Throughout the southern half of the pass, for a mile or so, there were evidences of much dislocation and displacement.

The pass opens out suddenly on the beautiful little vale of Meshuk, traversed by a stream of water fringed with a grove of magnificent willow-trees, some of whose trunks were 6 or 8 feet in diameter. The range on the east of the valley is of sandstone, but trap is also met with, though I am unable to say in what relative position. Here the limestone series ends; from this spot southward all is trap, varying in character, in different places, from basalt to soft ashy trap, in some places amygdaloid and vesicular, and containing zeolites, in others earthy and nodular, and interseamed with beds of a peculiar red earth, which is very often seen amidst the trap series of the Dekkan Hills.

From Meshek to Ashangi the country is wild in the extreme. The route passes over a range of mountains, reaching an elevation of 9800 feet, thence across a still higher range of 10,400 feet to Mukhan, and again over the forest-clad ranges which intervene, down into the valley of Ashangi, which lies at about the same elevation as Senafé, or perhaps somewhat higher. Beyond this I could not proceed, as I met here the force returning from Magdala.

Glancing, then, over what I have said, we find on the coast evidences of somewhat recent volcanic action in the trap-hills and the volcanic cone, with its scoria scattered around; while the temperature of the water so near the surface, and the existence of several hot springs in this sandy tract, as at Atfeh, and in the vicinity of Arkiko, point to a somewhat more than usual subterranean heat now existing.

The great mass of the mountain-ranges traversed by the Pass consist of metamorphic rocks some 5000 or 6000 feet in thickness, overlaid by trap. Then on the highlands sandstone, and sandstone overlaid by trap, extending from Senafé to Dongola, a distance of 70 miles; afterwards the limestone series for 60 miles, succeeded by trap to an indefinite distance.

This trap closely resembles the trap of the mountains of the Dekkan, and in appearance is identical; much of the limestone resembles, in general lithological character, the limestone strata of the secondary period, which underlies the nummulitic limestone of Scinde and Beloochistan. The most distinctive fossil we discovered in it is a *cidaris*, which seems to point to the oolitic series. The whole tract of this limestone-formation lies at a lower elevation, by some 1000 or 1200 feet, than that of the trap and sandstone north and south of it. Of its relative geological position and age I cannot speak decidedly, and, indeed, in this paper, desire only to sketch broadly the chief outlines of the geology of the country, and to trench as little as possible on what Mr. Blanford, the appointed geologist to the expedition, will have to say.

TABLE of HEIGHTS of the LINE of ROUTE of the ABYSSINIAN FIELD FORCE,
from SENAFÉ to ASHANGI.

Station.	Difference of Height of Barometer from the Standard Mean at Senafé.	Temperature.	Ratio per Tenth, in Feet.	Height.
Senafé	22·560	8·175
Gunguna	+ ·560	65	121	7·510
Fokada	- ·210	63	125	8·425
Addigerat	- ·100	65	125	8·300
Mai Wuhig	- ·410	61	126	8·679
Addabaga	+ ·100	62	124	8·050
Dongola	+1·220	66	118	6·736
Agula	+1·265	66	118	6·700
Dolo	+ ·790	66	121	7·207
Eikulitz	+ ·670	65	121	7·359
Chelicut	+1·150	65	120	6·800
Antalo Camp	+1·055	70	121	6·905
Musgi	+1·230	70	121	6·700
Meshuk	+ ·150	65	122	7·992
Pass, summit of	-1·663	60	136	10·420
Attala	- ·160	62	124	8·361
Pass, summit of	-2·210	56	137	11·189
Mukhan	- ·010	60	124	8·163
Ashangi	- ·135	65	126	8·343

Computed by Dr. Guyot's Table,

HENRY COOK, M.D.

2. *Discovery of a New Channel through the Forcados River to the Town of Warré.* By CHARLES LIVINGSTONE, H.M. Consul, Fernando Po.

(Communicated by the FOREIGN OFFICE.)

“MY LORD,

“A brisk trade in palm-nut kernels has opened up recently in Benin. The town of Warré is the chief seat of this trade; but it is said to be 150 miles from the sea by the tortuous channel of the Benin. Several English schooners have gone up to Warré notwithstanding, and lately a steamer, belonging to a Hamburg Company, has towed up one of their barques, and is making regular trips. Shortly before my visit, John H. Louche, Esq., of Glasgow, thinking that the Forcados might be a shorter path to Warré, explored it in his boat from Warré to the sea, and found abundance of water, and a straight channel. He mentioned this to the Hamburg captain, who came down in his steamer in five hours. The Benin Channel took twelve hours with the tide. He found a good bar with 20 feet of water, and fit for sailing-vessels. There is a capacious harbour inside the bar.

“The Forcados belongs to Chinomé, son of Queen Dolo, of Warré. He is willing to have the river used, and offers to protect any trader who may go to it.

“*Fernando Po*, Nov. 24, 1869.